U.S. Environmental Protection Agency
Region IX

Gualala River
Total Maximum Daily Load
for Sediment

Approved by:

/s/

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SECTION 1: INTRODUCTION

This Gualala River Total Maximum Daily Load (TMDL) for sediment is prepared as part of a Clean Water Act program to assure that State water quality standards are achieved and beneficial uses protected. Protection of cold water fish such as coho and steelhead from human caused erosion of sediment is the primary concern of this TMDL.

This TMDL is the second part of a three part program. The first part of the process put the Gualala River on a list of polluted waters, along with most North Coast rivers in California. Setting the TMDL is the second part of the program. The TMDL determines the level of the pollutant -- sediment -- which is allowable without exceeding water quality standards. The third part of the program will be when the State of California implements programs to achieve the TMDL. The California Regional Water Quality Control Board, North Coast Region (Regional Water Board) has the responsibility for implementation. As of December 2001, the Regional Water Board has not scheduled a date for adopting an implementation plan for this TMDL.

The Gualala River Total Maximum Daily Load (TMDL) for Sediment needs to be established in accordance with Section 303(d) of the Clean Water Act, because the State of California has determined that the water quality standards for the Gualala River are exceeded due to excessive sediment. In accordance with Section 303(d), the State of California periodically identifies waters where water quality standards are not being met. In its latest Section 303(d) list, adopted through Resolution 98-45 on 23 April 1998, the Regional Water Board identified the Gualala River as impaired due to elevated sedimentation.

In accordance with a consent decree (*Pacific Coast Federation of Fishermen's Associations, et al. v. Marcus*, No. 95-4474 MHP, 11 March 1997), December 2001 is the deadline for establishment of this TMDL. Because the State of California will not complete adoption of a TMDL for the Gualala River by this deadline, EPA is establishing this TMDL, with assistance from Regional Water Board staff.

The primary adverse impacts associated with excessive sediment in the Gualala River pertain to the salmonid fishery. The populations of Salmonids present in the Gualala River and its tributaries are in severe decline. The populations of coho salmon (*Oncorhynchus kisutch*), and steelhead trout (*O. mykiss*) are listed as threatened under the federal Endangered Species Act.

The purpose of the Gualala River TMDL is to identify the total load of sediment that can be delivered to the Gualala River and its tributaries without causing exceedence of water quality standards, and to allocate the total load among the sources of sediment in the watershed. Although factors other than excessive sediment in the watershed may be affecting salmonid populations (e.g., ocean rearing conditions), this TMDL focuses on sediment, the pollutant for which the Gualala River is listed under Section 303(d). EPA expects the Regional Water Board to develop an implementation strategy which will result in implementation of the TMDL in accordance with the requirements of 40 CFR 130.6. The load allocations, when implemented, are expected to result in the attainment of the applicable water quality standards for sediment for the Gualala River and its tributaries.


Ukiah
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Point Arena
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Gualala Watershed
Santa Rosa
Gualala Watershed
San Francisco

1.1. Watershed Characteristics

The Gualala River watershed, located in Northern California, flows into the Pacific Ocean near the Town of Gualala approximately 114 miles north of San Francisco and 17 miles south of Point Arena. The Gualala River drains approximately 300 square miles, or 191,145 acres, of mostly mountainous and rugged terrain in both Sonoma and Mendocino Counties. The county boundary runs down the center of the main stem Gualala River. The primary population centers are the towns of Gualala, Sea Ranch, Stewards Point, Annapolis and Plantation and are concentrated along the Pacific coastline.

The primary land use is predominantly timber production, along with grazing and rural residential development. Orchards and vineyards are also present. Approximately thirty-four (34%) percent of the Gualala watershed is owned by timber companies - Pioneer Resources, Gualala Redwoods and Mendocino Redwood Company. Unstable geology and high precipitation rates, typical of the Mendocino coast, make the region susceptible to high natural erosion and erosion caused by different land use practices. Disturbance to the natural landscape of the Gualala started around 1868, when harvesting of the old growth began. A second logging cycle is evident in 1952 aerial photos. By 1965, aerial photos of the watershed show large areas denuded of trees and scarred by roads and skid trails. This TMDL analyzes the period of 1978 - 2000. New erosion sources, plus old erosion sources that are still delivering sediment are analyzed to provide a picture of the current level of disturbance.

1.2. Information Sources

The Gualala River TMDL is based on the Gualala River Watershed Technical Support Document for Sediment (TSD),(California Regional Water Quality Control Board, August 2001). The TSD was prepared by Regional Water Board staff to provide technical information so EPA could establish the Gualala River TMDL. EPA relied on the TSD in preparing the Gualala TMDL and has not changed the State's interpretations of data in any way. The Regional Water Board staff used data on the Gualala River watershed from a variety of sources in the development of the TSD, which are described here in relevant sections and in detail in the TSD.

1.3. Endangered Species Act Consultation

EPA has initiated informal consultation with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service (the Services), on this action, under Section 7(a)(2) of the Endangered Species Act. Section 7(a)(2) states that each federal agency shall ensure that its actions are not likely to jeopardize the continued existence of any federally-listed endangered or threatened species.

EPA's consultation with the Services has not yet been completed. EPA believes that it is unlikely that the Services will conclude that the Total Maximum Daily Load (TMDL) that EPA is establishing violates Section 7(a)(2), since the TMDL and load allocations are calculated in order to meet water quality standards, and water quality standards are expressly designed to "protect the public health or welfare, enhance the quality of water and serve the purposes" of the Clean Water Act, which are to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Additionally, this action will improve existing conditions. However, EPA retains the discretion to revise this action if the consultation identifies deficiencies in the TMDL or allocations.

1.4. Organization

This report is divided into Sections. Section 2 (Problem Statement) describes the nature of the environmental problem addressed by the TMDL. Section 3 (Water Quality Indicators) identifies specific stream and watershed characteristics to be used to evaluate whether the Gualala River is attaining water quality standards. Section 4 (Source Analysis) describes what is currently understood about the sources of sediment in the watershed. Section 5 (TMDL and Allocations) identifies the total load of sediment that can be delivered to the Gualala River and its tributaries without causing exceedence of water quality standards, and describes how EPA is apportioning the total load among the sediment sources. Section 6 (Implementation and Monitoring Measures) contains recommendations to the State regarding implementation and monitoring of the TMDL. Section 7 (Public Participation) describes public participation in the development of the TMDL.

SECTION 2: PROBLEM STATEMENT

This Section summarizes how sediment is affecting the beneficial uses of the Gualala River and its tributaries associated with the decline of the cold water salmonid fishery. It includes a description of the water quality standards and salmonid habitat requirements related to sediment, and a qualitative assessment of existing instream and watershed conditions in the Gualala River basin.

2.1. Water Quality Standards

In accordance with the Clean Water Act, TMDLs are set at levels necessary to implement the applicable water quality standards. Under the Clean Water Act, water quality standards consist of designated uses, water quality criteria to protect the uses, and an antidegradation policy. The State of California uses slightly different language (i.e., beneficial uses, water quality objectives, and a non-degradation policy). This section describes the State water quality standards applicable to the Gualala River TMDL using the State's terminology. The remainder of the document simply refers to water quality standards.

The beneficial uses and water quality objectives for the Gualala River are contained in the *Water Quality Control Plan for the North Coast Region* (Basin Plan) as amended in 1996 (Regional Water Board 1996.) As defined in the Basin Plan (Regional Water Board 1996), the beneficial uses impaired by excessive sediment in the Gualala River are primarily those associated with the Gualala River's salmonid fishery, specifically: Commercial or Sport Fishing (COMM), Cold Freshwater Habitat (COLD), Estuarine Habitat (EST), Migration of Aquatic Organisms (MIGR), and Spawning, Reproduction, and/or Early Development (SPWN). These beneficial uses are presumed to be the most sensitive uses and presumed to protect any of the other beneficial uses that might be harmed by sediment.

The Basin Plan (Regional Water Board 1996) identifies both numeric and narrative water quality objectives for the Gualala River. Those pertinent to the Gualala River TMDL are listed in Table 2-1.

Table 2-1. Water Quality Objectives Addressed in the Gualala River TMDL

Parameter	Water Quality Objective
Suspended Material	*Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.*
Settleable Material	*Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses.*
Sediment	*The suspended sediment load and suspended sediment discharge rate of surface water shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.*
Turbidity	*Turbidity shall not be increased more than 20 percent above naturally occurring background levels. Allowable zones of dilution with which higher percentages can be tolerated may be defined for specific discharges upon the issuance of discharge permits or waiver thereof.*

In addition to water quality objectives, the Basin Plan (Regional Water Board 1996) includes two prohibitions specifically applicable to logging, construction, and other associated nonpoint source activities:

- *the discharge of soil, silt, bark, sawdust, or other organic and earthen material from any logging, construction, or associated activity of whatever nature into any stream or watercourse in the basin in quantities deleterious to fish, wildlife, or other beneficial uses is prohibited; and*

- *the placing or disposal of soil, silt, bark, slash, sawdust, or other organic and earthen material from any logging, construction, or associated activity of whatever nature at locations where such material could pass into any stream or watercourse in the basin in quantities which could be deleterious to fish, wildlife, or other beneficial uses is prohibited.*

2.2. Decline of Salmon and Steelhead

Available data on fish populations indicate that beneficial uses for cold water fish are not being protected. The Regional Board compiled existing information on historic fish populations and surveys in the Gualala watershed. As described in the TSD, historic estimates of fish populations since the 1950s, angler surveys, spawner surveys, summer electrofishing, species composition surveys and snorkel surveys were reviewed to determine the health of salmonid populations in the Gualala. Both coho and steelhead were historically present in the watershed; chinook was not found to be present historically.

Although yearly population trend data is not available the population of coho has cleared declined. Coho were once plentiful throughout the watershed, but have all but vanished. Historic estimates were in the thousands, but coho were not observed during electrofishing surveys or other studies in the 1980s and 1990s, except for the Little North Fork. Nine adult coho were reported sighted during the winter of 1999-2000.

Steelhead have been observed throughout the entire watershed historically. The TSD concluded that "available information indicates that the (steelhead) populations show a pattern of decline. However, it does appear that steelhead continue to be present in most tributaries throughout the watershed." The Regional Water Board reviewed juvenile density studies, angler effort studies and snorkel surveys. It is not surprising that yearly population trend data was not available for the Gualala, as this type of data is only available for a few rivers in the North Coast.

Declining numbers of Salmonids have led the National Marine Fisheries Service to list several populations (known as Evolutionarily Significant Units) under the federal Endangered Species Act. As described in Table 2-2, the populations of coho and steelhead in the Gualala River and its tributaries have been listed as threatened (i.e., they are likely to become endangered in the foreseeable future). As noted previously, chinook salmon were not found to be present historically in the Gualala River.

Table 2-2. Salmonids in the Gualala River and its Tributaries Listed Under the Endangered Species Act

Species	*Evolutionarily Significant Unit*	*Status*	*Listing Date*
Coho Salmon	*Central California Coast*	*threatened*	*1996*
Steelhead Trout	*Northern California*	*threatened*	*2000*

The Gualala River TMDL addresses sediment impairments to water quality. Salmonid populations are affected by a number of factors, some of which (e.g., ocean rearing conditions) occur outside of the watershed. The TSD also compiled data and reviewed factors related to stream temperature and large woody debris. This TMDL focuses on achievement of water quality standards related to sediment, which will facilitate, but not guarantee, population recovery.

2.3. Salmonid Life Cycle and Water Quality Requirements

Salmonids have a five-stage life cycle. Healthy habitat conditions are crucial for the survival of each life stage. First, adult Salmonids lay their eggs in clean stream or lake gravels to incubate. Second, the eggs hatch and young fish seek shelter in the pools and adjacent wetlands. Third, juvenile fish leave the stream or lake, migrate down river, and reside in the estuary to feed and adjust to saltwater for up to a year before continuing onto the ocean. Fourth, juvenile fish mature in the ocean. And fifth, adult fish return to their home stream or lake to spawn. This cycle from spawning area to the ocean and back defines Pacific Salmonids as "anadromous." Most Pacific Salmonids die after spawning: their total energies are devoted to producing the next generation, and their bodies help enrich the stream for that generation.

Salmonids have a variety of requirements related to sediment. Salmonids have different water quality and habitat requirements at different life stages. Sediment of appropriate quality and quantity is needed for redd (i.e., salmon nest) construction, spawning, and embryo development. However, excessive amounts of sediment or changes in size distribution (e.g., increased fine sediment) can adversely affect salmonid development and habitat.

Excessive fine sediment can reduce egg and embryo survival and juvenile salmonid development. Kondolf (2000) reviewed the various studies relating measures of sediment quality to salmonid spawning success. Excess fine sediment can prevent adequate water flow through salmon redds, which is critical for maintaining adequate oxygen levels and removing metabolic wastes. Deposits of these finer sediments can also prevent hatching salmon from emerging from the redds, resulting in smothering. Excess fine sediment can also cause gravels in the water body to become embedded (i.e., the fine sediment surrounds and packs-in against the gravels), which effectively cements them into the channel bottom. Embeddedness can prevent the spawning salmon from building their redds.

Excessive fine or coarse sediment can also adversely affect the quality and availability of salmonid habitat by changing the structure and shape of the stream. It can reduce overall stream depth and the availability of shelter, and it can reduce the frequency, volume, and depth of pools. CDFG habitat data indicate that coho in Northern California tend to be found in streams that have as much as 40% of their total habitat in primary pools (Flosi et al. 1998). Pools in first and second order streams are considered primary pools when they are at least as long as the low-flow channel width, occupy at least half the width of the low-flow channel, and are two feet or more in depth. Primary pools in third order and larger channels are defined similarly, except that pool depth must be three feet or more. Pools provide salmon with protection from predators, a food source, and resting location.

Excessive sediment can affect other factors important to Salmonids. Stream temperatures can increase as a result of stream widening and pool filling. The abundance of invertebrates, a primary food source for juvenile Salmonids, can be reduced by excessive fine sediment. Large woody debris, which provides shelter, can be buried. Increased sediment delivery can also result in elevated turbidity, which is highly correlated with increased suspended sediment concentrations. Increases in turbidity or suspended sediment can impair growth by reducing availability or visibility of food sources, and the suspended sediment can cause direct damage to the fish by clogging gills.

2.4. Habitat Conditions in the Gualala River Watershed

Available data show that the aquatic habitat related to sediment is poor compared to conditions considered healthy for Salmonids. The Regional Board compiled and reviewed the available information on aquatic habitat conditions in streams in the Gualala watershed. The TSD notes that available data is limited and mainly available on timber company lands. While residents note large historic changes in stream channel conditions where the streams have filled with sediment, measured trend data is largely absent. Available data on different measurements of salmonid habitat (such as fine sediment measurements, pool depth and mean particle diameter (D50), and V*) all indicate streams where sediment conditions are poor when compared to levels considered healthy for Salmonids. Given the limited samples collected and the limited geographic extent of the Gualala which has been monitored, the details of the monitoring are not discussed here. Details are provided in the TSD. However, the Regional Board notes that measurements in the tributary of Dry Creek indicate better conditions. It is hoped that the North Coast Watershed Assessment Program, now in progress, will provide a more comprehensive picture of stream conditions in the Gualala.

SECTION 3: WATER QUALITY INDICATORS

This Section identifies water quality indicators that are more specific to the Gualala River and generally more quantifiable than the water quality standards for sediment contained in the Basin Plan (see section 2.1). They are interpretations of the water quality standards expressed in terms of instream and watershed conditions. For each indicator, a numeric or qualitative target value is identified to define the desired condition for that indicator. EPA expects that these indicators, and their associated target values, will provide a useful reference in determining the effectiveness of the TMDL in attaining water quality standards, although they are not directly enforceable by EPA.

No single indicator adequately describes water quality related to sediment, so a suite of instream and watershed indicators is identified. Because of the inherent variability associated with stream channel conditions, and because no single indicator applies in all situations, attainment of the targets is intended to be evaluated using a weight-of-evidence approach. When considered together, the indicators are expected to provide good evidence of the condition of the stream and attainment of water quality standards.

Instream indicators reflect sediment conditions that support Salmonids. They relate to instream sediment supply and are important because they are direct measures of stream "health."

In addition to instream indicators, we are including watershed indicators in this TMDL because watershed indicators focus on imminent threats to water quality that can be detected and located before the sediment is actually delivered to the stream, and because watershed indicators are often easier to measure than instream indicators. These watershed indicators are established to identify conditions in the watershed needed to protect water quality. They are set at levels associated with well-functioning watersheds.

Watershed indicators assist with the identification of threats to water quality for several reasons. Watershed indicators reflect conditions in the watershed at the time of measurement, whereas instream indicators can take years or decades to respond to changes in the watershed, because linkages between hillslope sediment production and instream sediment delivery are complicated by time lags from production to delivery, instream storage, and transport through the system. Also, watershed indicators tend to reflect local conditions, whereas instream indicators often reflect upstream watershed conditions as well as local conditions. Both instream and watershed indicators are appropriate to use in describing attainment of water quality standards.

Table 3-1 lists the water quality indicators for the Gualala River TMDL and their respective target values. Details on the monitoring procedures and scientific basis for these indicators and the target values are found in the TSD.

INDICATOR	TARGET	DESCRIPTION	PURPOSE	REFERENCES[1]
Short Term - measures of stream health and sediment supply; measure every few years				
V* - lower order streams (smaller streams)	# 0.15	Fraction of pool volume filled by fine sediment	Correlated with annual sediment yield	Lisle and Hilton 1992, 1999, Knopp 1993
Fine sediment volume of active bed matrix	decreasing trend in volume stored		Tracks instream fine sediment storage; aids in interpretation of V*	Lisle and Hilton 1999
Percent Fines# 0.85 mm	# 14%	% of streambed material sorted by size, sampled at spawning sites	Indirect measure of spawning gravel suitability	Burns 1970, Peterson et al. 1992
Percent Fines# 6.4 mm	# 30%	“ ”	“ ”	Kondolf 2000
Riffle embeddedness	# 25% or improving trend	percent of a cobble surrounded by fine sediment, estimated where spawning is likely	Indirect measure of spawning gravel suitability	Flosi et al. 1998
Aquatic Insect Community Measurements	improving trends	measures of insect diversity and measures of “clean water” insects	Measure of stream health	CDFG, 1996
Hydrologic Connectivity of Roads	# 5% length of road draining to stream		Prevents sediment delivery to streams	Weaver and Hagans 1994
Stream Diversion Potential at Road Crossings	< 1%	diversions down the road and out of its channel as a result of stream crossing exceedence	Prevents sediment delivery to streams	Furniss et al 1997, Weaver and Hagans 1984

[1] References are as cited in the TSD.

Stream Crossings with High Risk of Failure	# 1%	“ ”	Prevents sediment delivery to streams	NMFS 2000, Flanagan et al 1998
Mid-Term Targets and Indicators - Responsive after restoration activities; dependant upon frequency and magnitude of storm events				
Turbidity	< 20% above naturally occurring background levels	measure of stream clarity	Highly correlated with sediment delivery, measure of feeding/growth of Salmonids	Basin Plan
Turbidity	decreasing days above threshold	Measure of stream clarity	Measure of feeding/growth of Salmonids	Newcombe and Jensen 1996, Sigler et al. 1984
Suspended Sediment Concentration Rating Curve	Decreasing temporal trend	Relationship between flow and suspended sediment	Measure of sediment delivery	
V* - higher order streams (larger streams)	# 15%	Fraction of pool volume filled by fine sediment	Estimate of sediment filling of pools by erosion	Lisle and Hilton 1992, 1999, Knopp 1993
Residual Pool Depth	2 feet - first & second order streams 3 feet - higher order streams	Depth of pool at zero flow	Characteristic of better coho streams	Flosi et al. 1998
Stream Crossing Failures	Decreasing Trend		Measures reduced sediment delivery	
Thalweg Variability	Increasing variation from the mean	Deepest part across a stream channel	Estimate of improving habitat complexity and availability	
Annual Road Inspection and Correction	Increased length to 100%		Prevents sediment delivery to streams	USEPA 2000

Road Location, surfacing and sidecast	Decreased road length next to stream, increased % of outsloped and hard surfaced roads	roads with greater risk of sediment delivery are minimized	Prevents identified problems of sediment delivery	EPA 1998
Activity in unstable areas	Avoid or eliminate, unless detailed geologic assessment	Unstable areas include steep slopes, inner gorges, stream banks etc.	Reduces risk of landslides	Dietrich et al 1998, EPA, 2000
Disturbed Area	Decrease or decrease in disturbance index	Disturbed area = area covered by roads, landings, skid trails, agriculture etc.	Correlated with suspended sediment	Lewis 1998
Long Term Numeric Targets and Indicators - these parameters might not respond until decades after restoration activities have been accomplished. They are dependent upon infrequent storm events that alter stream channel configuration and trigger landslides				
Large Woody Debris	Increasing distribution, volume and number of key pieces	a piece of woody material >12" in diameter and 6 feet in length that could enter a stream	LWD improves salmon habitat (pools, cover, sediment metering etc.)	Bilby and Ward 1989,
Proportion of Stream Length in Pools	$ 40%		Characteristic of better coho streams	Flosi et al. 1998
Road Related Landslides	Decreasing Trend		Measures reduced sediment delivery	

SECTION 4: SOURCE ANALYSIS

The purpose of the sediment source analysis is to identify the sources of sediment that are affecting aquatic habitat. Sources of sediment delivery to aquatic habitat include natural erosion processes as well as those influenced by anthropogenic (e.g. human-caused) activities, such as road construction and timber harvest.

The Regional Water Board staff developed the sediment source analysis, as described in more detail in the TSD. The sediment source analysis focuses on estimating rates of sediment delivered in the recent past because during this period, road building, maintenance and timber harvest practices were the same as those currently practiced.

Several different methods were used to identify and quantify sediment delivered to streams. Air photos were analyzed (1978, 1988, 1999/2000) to identify landslides and roads. A portion of these features identified in photos were field checked to assist with quantification of amount of sediment delivered and determination of cause from the large features. In addition, because air photos are most useful in identifying larger features, the air photo analysis was supplemented with field measurement of smaller erosion features and calculation of surface erosion amounts. Field plots were randomly selected after areas were stratified into similar geology and vegetation. Regional Board staff were granted access to 17 plots, primarily on industrial timber company lands. Because of the access limitations, the erosion estimates from the random field plots were extrapolated to all lands in the Gualala, rather than extrapolated from the original stratified design. In addition, a special study of public roads was undertaken. Regional Water Board staff also took additional measurements of a main haul road to supplement the random field plots. Detailed discussion of methods, extrapolation and limitations are provided in the TSD.

Table 4-1 provides road density information at two watershed scales. In general, the higher the road density the higher the overall sediment delivery from roads (see Table 4-2.) For example, Buckeye and North Fork have a road density of approximately 6 miles per square mile and a road related sediment delivery of about 900 tons/square mile/year. In contrast, the other three subwatersheds have less than 5 miles per square mile of road, resulting in less than 700 tons/square mile/year.

Table 4.1 Road Density by Planning Watershed and Subwatershed

Planning Watershed No.	Planning Watershed	Subwatershed	Road Density (MI/SQ MI)
1113810001	Stewart Creek	North Fork	7.0
1113810002	Robinson Creek	North Fork	6.4
1113810003	Doty Creek	North Fork	7.6
1113810004	Billings Creek	North Fork	4.5
Subwatershed average		**North Fork**	**6.1**
1113820001	Middle Rockpile Creek	Rockpile Creek	5.9
1113820002	Red Rock	Rockpile Creek	7.5
1113820003	Lower Rockpile Creek	Rockpile Creek	5.9
1113820004	Upper Rockpile Creek	Rockpile Creek	2.8
Subwatershed average		**Rockpile Creek**	**4.8**
1113830001	Flat Ridge Creek	Buckeye Creek	4.7
1113830002	Harpo Reach	Buckeye Creek	4.2
1113830003	Grasshopper Creek	Buckeye Creek	6.5
1113830004	Little Creek	Buckeye Creek	8.1
1113830005	NF Osser Creek	Buckeye Creek	4.1
Subwatershed Average		**Buckeye Creek**	**5.7**
1113840101	Tombs Creek	Wheatfield Fork	3.3
1113840102	Wolf Creek	Wheatfield Fork	3.4
1113840103	Buck Mountain	Wheatfield Fork	3.2
1113840201	Pepperwood Creek	Wheatfield Fork	2.9
1113840202	House Creek	Wheatfield Fork	3.1
1113840203	Britain Creek	Wheatfield Fork	3.5
1113840301	Haupt Creek	Wheatfield Fork	3.2
1113840302	Flat Ridge Creek	Wheatfield Fork	6.7
1113840303	Annapolis	Wheatfield Fork	6.1
1113840304	Tobacco Creek	Wheatfield Fork	4.3
Subwatershed Average		**Wheatfield Fork**	**4.0**
1113850101	Upper Marshall Creek	Gualala	3.8
1113850102	Lower Marshall Creek	Gualala	3.8
1113850103	Middle South Fork Gualala Riv	Gualala	3.6
1113850104	Upper South Fork Gualala River	Gualala	3.9
1113850201	Big Pepperwood Creek	Gualala	7.9
1113850202	Mouth of Gualala River	Gualala	7.0
Subwatershed Average	**South Fork**	**Gualala**	**4.8**

Table 4-2 provides the results of the Sediment Source analysis. Natural sediment sources currently account for approximately 1/3 of the total sediment delivered to the Gualala watershed, while 2/3 is human-caused. The analysis also shows that road related erosion is the major portion of the human caused erosion.

Table 4.2 Results of the Sediment Source Analysis

Sediment Source	Estimated Sediment Delivery (tons/mi2/yr)						
	Buckeye	North Fork	Rockpile	South Fork	Wheatfield	**Watershed Average**	
Natural Landslides	170	170	210	190	180	**180**	**Natural: 380**
Natural Stream Bank Erosion	190	200	180	220	200	**200**	
Road Related Landslides	450	580	350	290	310	**370**	**Human-Caused: 840**
Road-Stream Crossing Failures	70	70	60	40	40	**50**	
Road Related Gullying	190	80	40	130	210	**150**	
Road Related Surface Erosion	210	160	100	150	120	**140**	
Skid Trail Surface Erosion	40	60	20	20	20	**30**	
Other Harvest Related Delivery	80	90	60	110	110	**100**	
Totals	1400	1410	1020	1150	1190	**1220**	

SECTION 5: TMDL AND ALLOCATIONS

The purpose of this Section is to determine the total loading of sediment which the Gualala River and its tributaries can receive without exceeding water quality standards, and to apportion the total among the sources of sediment.

5.1. TMDL

This TMDL is set equal to the loading capacity of the stream. It is the estimate of the total amount of sediment, from both natural and human-caused sources, that can be delivered to streams in the Gualala River watershed without exceeding applicable water quality standards. Recall that the State's water quality standards state "..sediment loads...shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses..." The beneficial use most sensitive to sediment impacts in the Gualala watershed is the cold water fishery. Thus the loading capacity is determined to be the amount of sediment that can be introduced in the Gualala without adversely affecting the cold water fishery.

The best available science does not yet provide for a complex model which links sediment delivery with the quality of aquatic habitat in a way that takes into account the natural rainfall variability, temporal and spatial lags of sediment delivery, movement and storage. Therefore, for North Coast sediment TMDLs, EPA has used three approaches for deriving the loading capacity: (1) a comparison with a reference time period; (2) a comparison with a reference stream; and (3) the estimated needed improvement from existing loading rates, based on a comparison between current and target instream conditions. The approach used in a particular TMDL depends on the availability of data and the characteristics of the specific watershed. For the Gualala River TMDL, the Regional Water Board did not have data about the Gualala to make watershed estimates of either an historic reference period or a local reference stream. Therefore, the TMDL is being set adopting the approach used for the South Fork Eel, Navarro and Ten Mile TMDLs, which uses information on sediment delivery during healthy aquatic conditions from a similar watershed and applies the sediment delivery information to the Gualala.

The TMDL sets 125% of natural sediment delivery as the level that would protect aquatic habitat. Information from the Noyo watershed was used to develop this figure. Specifically, Salmonids were still abundant in the Noyo during the 1933-1957 period, so the corresponding sediment delivery during this period must have allowed salmonid habitat of suitable quality to persist. In the Noyo River, the total sediment delivery was estimated to be 125% of the natural sediment. This ratio is then applied to the natural background sediment levels estimated for the Gualala River in the sediment source analysis. Given the proximity of the Noyo to the Gualala, as well as their similarities in climate, geology, vegetation, and land use history, EPA and the Regional Board conclude that this approach is reasonable.

Therefore, the TMDL for the Gualala River and its tributaries is:

TMDL = 475 tons/mi^2/yr (10 year average)

This number was derived using the sediment source analysis estimate for background of 380 tons/square mile/year over the last 20 years and multiplying it by 1.25. Given that the current rate of erosion which is associated with roads, road maintenance and timber harvest practices is 840 tons/square mile/year, this analysis implies that for the Gualala watershed significant reductions in human induced erosion are needed to protect aquatic habitat and cold water fish. Given the hydrologic variability typical of the Northern

California Coast Ranges, EPA expects the TMDL to be evaluated as a ten-year rolling average.

5.2. Allocations

In accordance with EPA regulations, the loading capacity (i.e., TMDL) is allocated to the various sources of sediment in the watershed, with a margin of safety. That is,

TMDL = sum of the wasteload allocations for individual point sources;
+ sum of the load allocations for individual nonpoint sources; and
+ sum of the load allocations for background sources.

The margin of safety in this TMDL is not added as a separate component of the TMDL, but rather is incorporated into conservative assumptions used to develop the TMDL, as discussed in Section 5.3 below. As there are no significant individual point sources of sediment in the Gualala River watershed, the wasteload allocation for point sources is set at zero. Thus, the TMDL for sediment for the Gualala River and its tributaries is apportioned among the categories of background and nonpoint sources of sediment identified in the source analysis (see Section 4), as load allocations.

In addition to ensuring that the sum of the load allocations equals the TMDL, the Regional Water Board and EPA considered several factors related to the feasibility and practicability of controlling the various nonpoint source sediment sources.

The load allocations for nonpoint sources reflect best professional judgment of the Regional Water Board of what is reasonably attainable by available erosion control techniques. The TSD outlines the various erosion control techniques available to reduce erosion from roads and timber harvest practices, including outsloping of roads, changes in road drainage, construction of armored fords etc. The load allocations provide a watershed view of the type of effort which will be required in the Gualala watershed, however, the Regional Board notes that a site specific approach for implementation may vary the specific reductions needed on different ownerships or land areas due to erosion sources or cost-effectiveness.

Table 4-2 shows the sediment source loading allocations for the Gualala watershed as a whole.

Sediment Source	Current Load	Load Allocation
	(tons/mi2/yr)	(tons/mi2/yr)
Natural Landslides	180	180
Natural Streambank Erosion	200	200
Road-Related Landslides	370	56
Road-Stream Crossing Failures	50	5
Road-Related Gullies	150	8
Road-Related Surface Erosion	140	7
Skid Trail Surface Erosion	30	5
Other Harvest Related Delivery	100	14
TOTAL	**1220**	**475**

The load allocations are expressed in terms of yearly averages (tons/mi^2/yr). They could be divided by 365 to derive daily loading rates (tons/mi^2/day), but EPA is expressing them as yearly averages, because sediment delivery to streams is naturally highly variable on a daily basis. In fact, EPA expects the load allocations to be evaluated on a ten-year rolling average basis, averaged over the entire watershed, because of the natural variability in sediment delivery

5.3. Margin of Safety

The margin of safety is included to account for uncertainties concerning the relationship between pollutant loads and instream water quality and other uncertainties in the analysis. The margin of safety can be incorporated into conservative assumptions used to develop the TMDL, or added as an explicit separate component of the TMDL.

The margin of safety for this TMDL for the Gualala River is implicit in the assumptions used. Although the most reasonable, scientifically based assumptions were used during the preparation of the sediment source analysis, two assumptions err significantly towards protection of the resource. The first assumption is on extrapolation of measurements made from field plots to the entire watershed. In the Gualala sediment source analysis, the Regional Board made efforts to gain access from all types of lands, however, access was granted primarily by large industrial timber companies. While the original project design was to stratify lands by geology and vegetation and then extrapolate, the final numbers were calculated extrapolating primarily from conditions on industrial timber company lands. The Regional Board believes that ranch lands are actually in better condition than industrial timber lands and therefore these lands may be closer to meeting the TMDL than assumed here. Another assumption that provides for additional protection of the resource is the estimation of earthflow delivery. Earthflow delivery is likely to be an underestimate. Since the loading allocations are based on the natural sediment delivery, an underestimate of natural results in a lower TMDL and therefore errs towards protection of the resource.

5.4. Seasonal Variation and Critical Conditions

The TMDL must describe how seasonal variations were considered. Sediment delivery in the Gualala River watershed inherently has considerable annual and seasonal variability. For this reason, the TMDL and load allocations are designed to apply to the sources of sediment, not the movement of sediment across the landscape, and to be evaluated on a ten-year rolling average basis.

The TMDL must also account for critical conditions for stream flow, loading, and water quality parameters. Rather than explicitly estimating critical flow conditions, this TMDL uses indicators which reflect net long term effects of sediment loading and transport. These indicators are for both instream conditions and watershed conditions to assure that the lag times in watershed disturbance reflected in streams are taken into account. In addition, critical conditions for sediment delivery are during periods of high rainfall and high stream flow. The photo analysis accounts for a recent period that included a period of high stream flow.

SECTION 6: IMPLEMENTATION AND MONITORING MEASURES

The main responsibility for water quality management and monitoring resides with the State. EPA fully expects the State to develop and submit implementation measures to EPA as part of revisions to the State water quality management plan, as provided by EPA regulations at 40 C.F.R. Sec. 130.6.   As of this TMDL , the Regional Water Board has not developed an implementation program for the Gualala River.

The State implementation measures should contain provisions for ensuring that the TMDL will in fact be achieved. These provisions may be non-regulatory, regulatory, or incentive-based, consistent with applicable laws and programs, including the State's recently upgraded nonpoint source control program. Furthermore, the State implementation and monitoring plans should be designed to determine if the TMDL is meeting water quality standards and protecting beneficial uses.   This TMDL uses both instream indicators and sediment delivery as complementary methods of evaluating attainment of water quality standards. Given the varying timescale of response for various indicators and sediment delivery (dependent on large storms, sediment storage patterns etc.) many factors must be included in evaluating the effectiveness of the TMDL. Given the constantly advancing science and the costs of implementation, designing implementation and monitoring programs to resolve ongoing uncertainties (known as adaptive management) is consistent with the TMDL program.

SECTION 7: PUBLIC PARTICIPATION

EPA regulations require that TMDLs be subject to public review (40 CFR 130.7). EPA provided public notice of the draft Gualala River sediment TMDL by placing a notice in the Santa Rosa Press Democat and Independent Coast Observer of general circulation in the Gualala River watershed. EPA prepared a written response to all written comments on the draft TMDLs received by EPA through the close of the comment period October 5, 2001.

The EPA draft and final TMDL is based on the TSD prepared by Regional Water Board staff. Regional Water Board staff provided for public participation in the development of the TSD through several mechanisms. Meetings were held with representatives of a number of stakeholder groups in the watershed, including the Gualala River Watershed Council, timber companies, and vineyard interests. Regional Board Staff have also made contact with local, state, and federal regulatory agency staff working in the watershed. A two-page description of the field measurement of random plots was included in a newsletter distributed by the Gualala River Watershed Council in the spring of 2001. A more in-depth description of the random plot field measurements and a general description of how it fit into the 303(d) process was sent to over 90 landowners in the watershed. Also, staff were able to meet many landowners and discuss 303(d) issues while completing field work.

Regional Board staff hosted a meeting with EPA in Gualala in the August 2001 to explain the methods used to develop the TSD and TMDL and answer questions.

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